XXIII IUFRO WORLD CONGRESS

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Comparing YieldSAFE and CABALA, two process-based models with contrasting parameter requirements

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Seoul, South Korea

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Sustainable Ecosystems, CSIRO, Hobart, TAS, Australia

ForChange

Forest Ecosystem Management Under Global Change

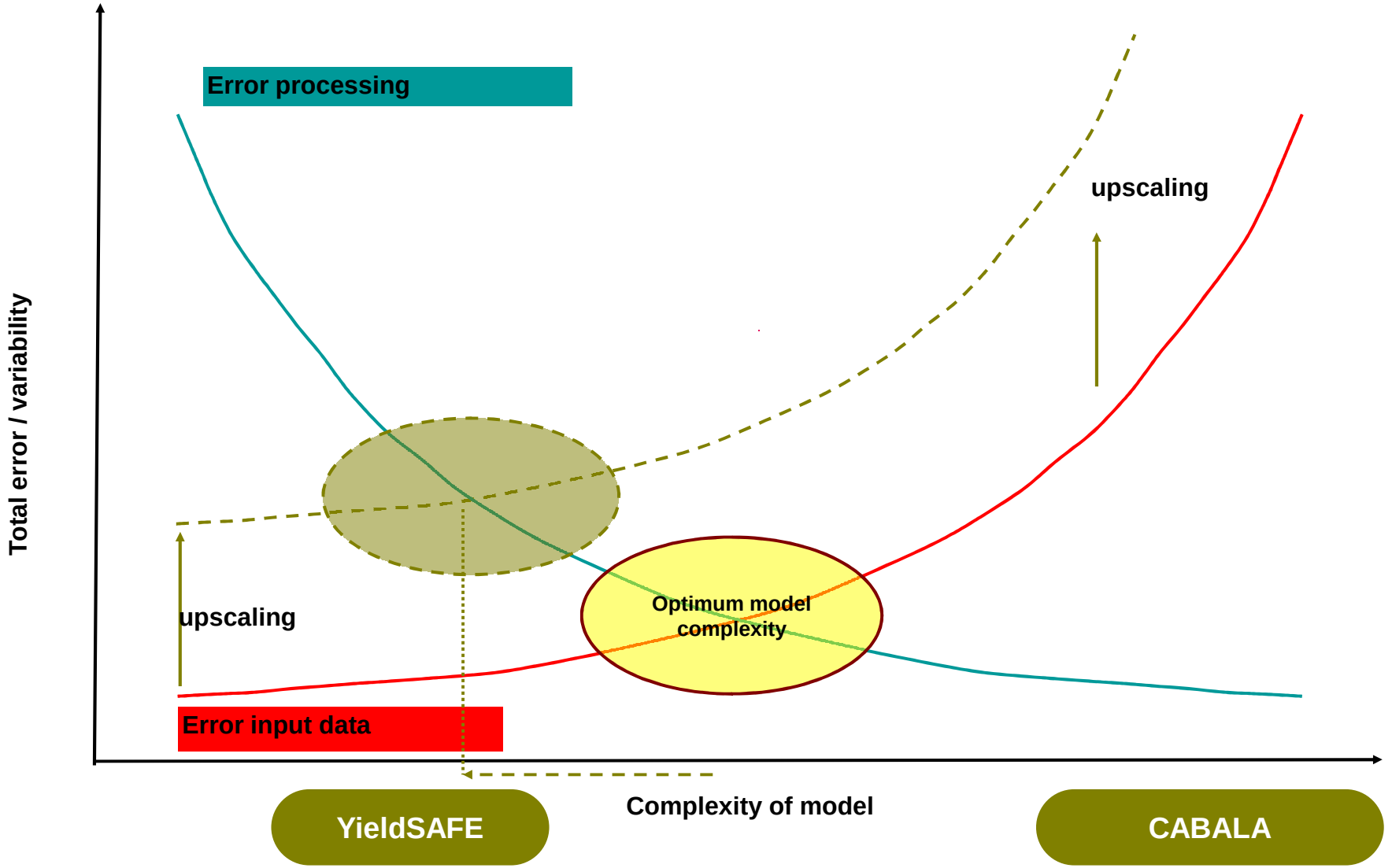
CSIRO

CABALA vs YieldSAFE

	CABALA	YieldSAFE
Parameters (and initial conditions)	102	11 (tree) + 13 (crop)
State variables	37 (+6)	22
Simulation time (10 years) (CPU @ 2.4 GHz)	26 sec	2 sec
Implementation	VB.net	MSExcel
reference	Battaglia et al 2004, For Ecol Man 193, 251-282	Van der Werf et al 2007, Ecol Eng 29 (4) 419-433

CABALA vs YieldSAFE

A **GOOD** model can only give **GOOD** results if **GOOD** input data is supplied



YieldSAFE : usage of available data

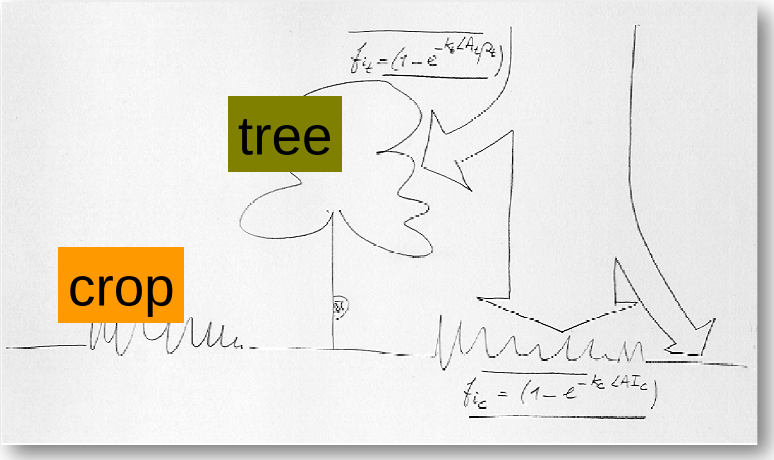
US 12 classes parameters for Mualem van Genuchten function
Schaap, M. G. and F. J. Leij (1998). "Database-related accuracy and uncertainty of pedotransfer functions." Soil Science 163(10): 765-779. Cited 109 times

EU – FAO 5 classes parameters for Mualem van Genuchten function
Wösten, J., A. Lilly, et al. (1999). "Development and use of a database of hydraulic properties of European soils." Geoderma 90: 169-185. Cited 153 times

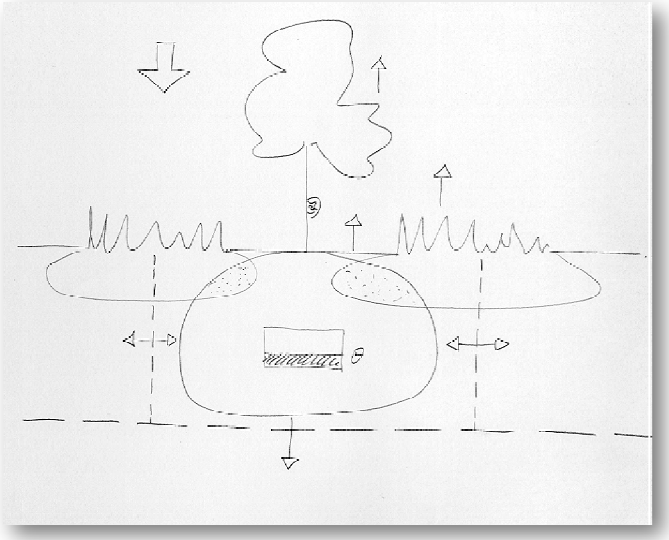
Potential Yield is usually available in national databases

YieldSAFE : an agroforestry model

Light

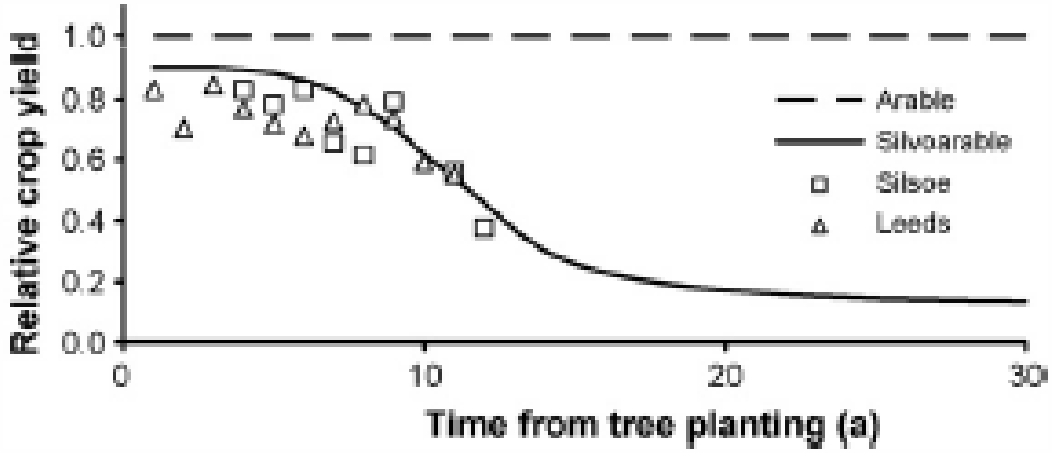


Water

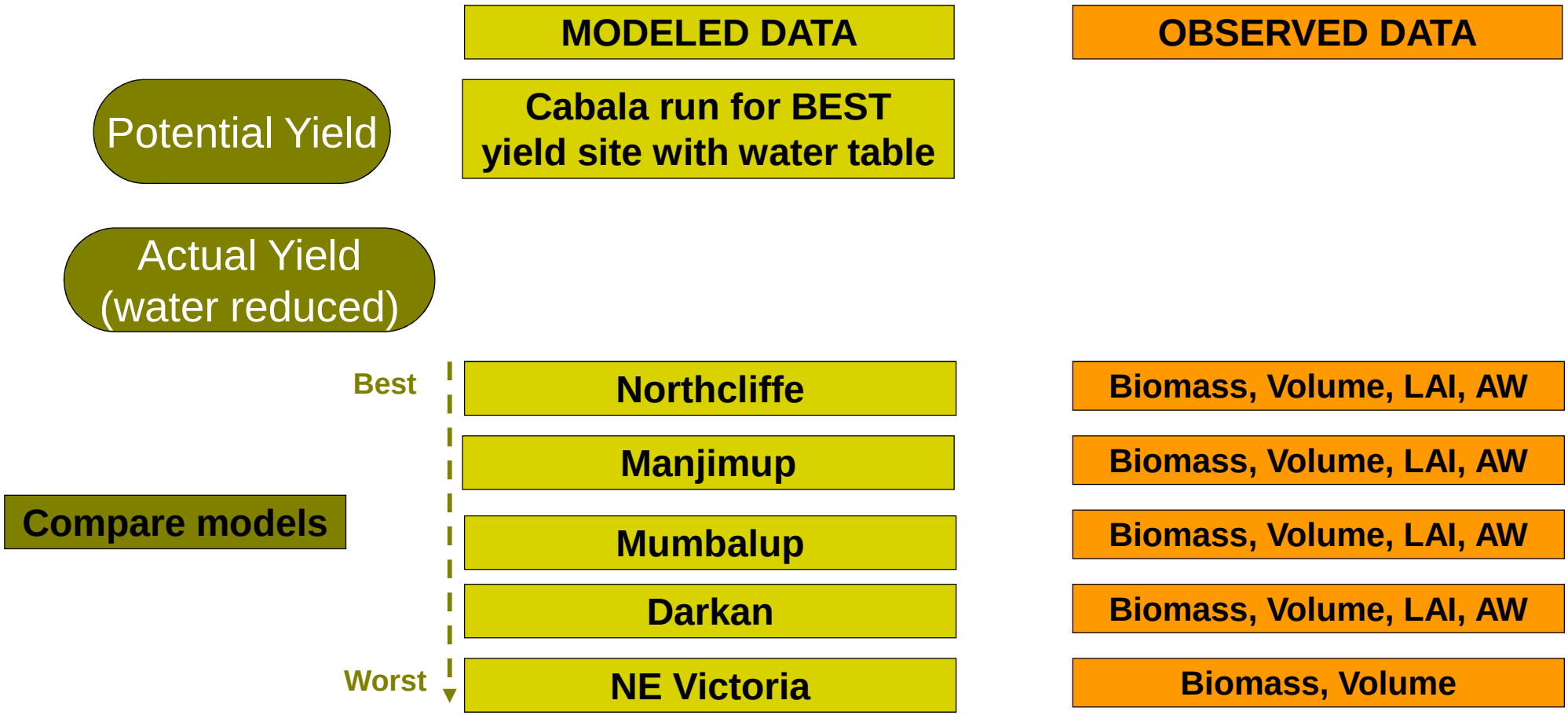


Can work as:

Forest Monoculture
Crop ~~monoculture~~
Agroforestry system



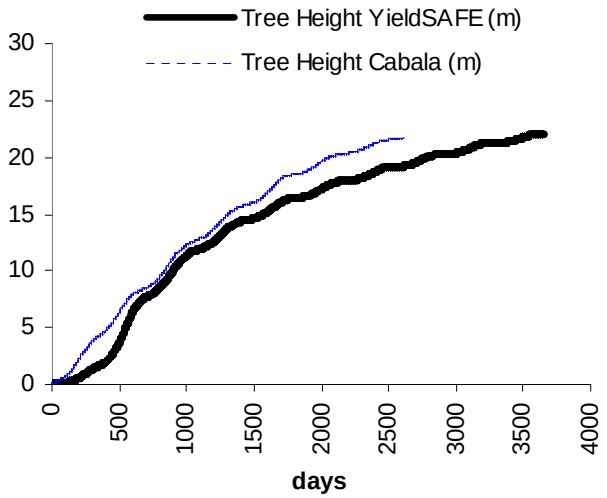
YieldSAFE Calibration Process

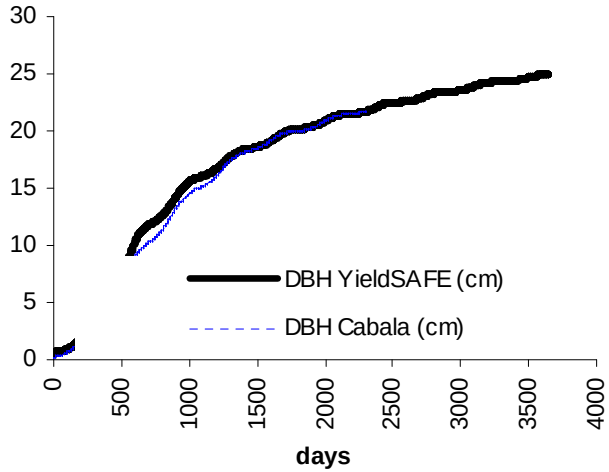


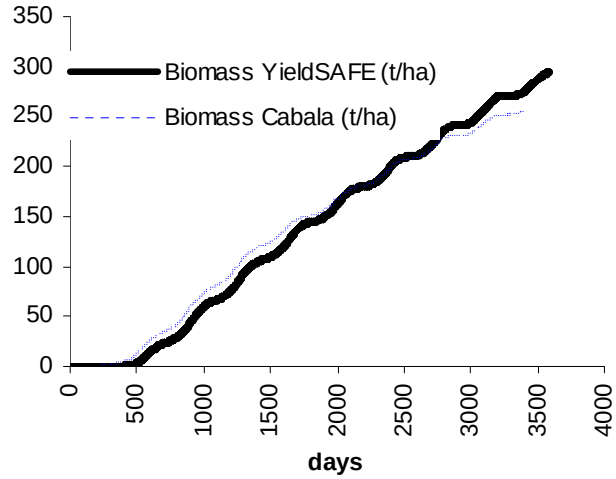
CABALA vs YieldSAFE

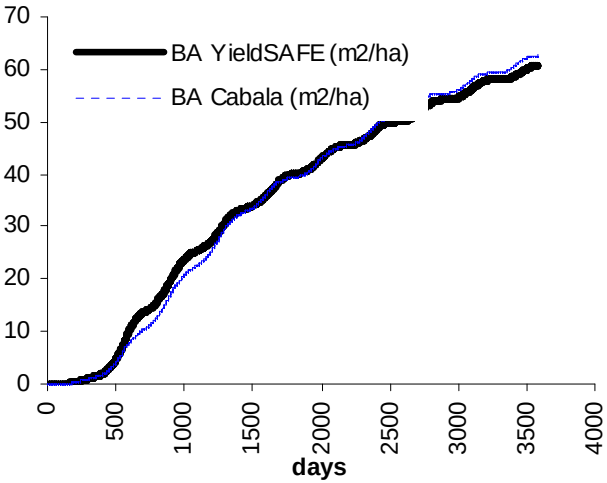
Potential Yield

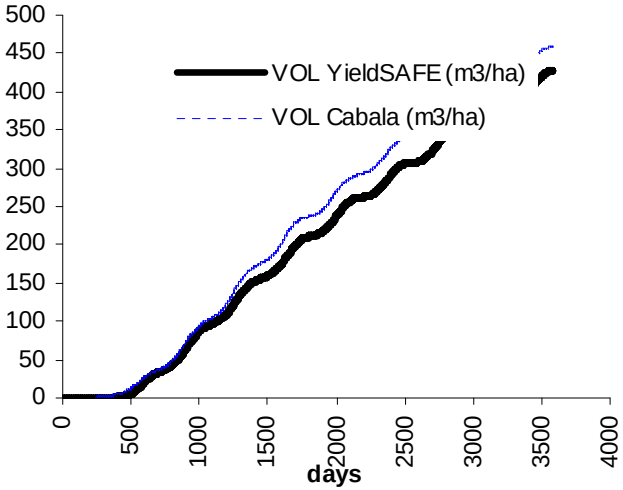
Fitted parameters for potential yield.

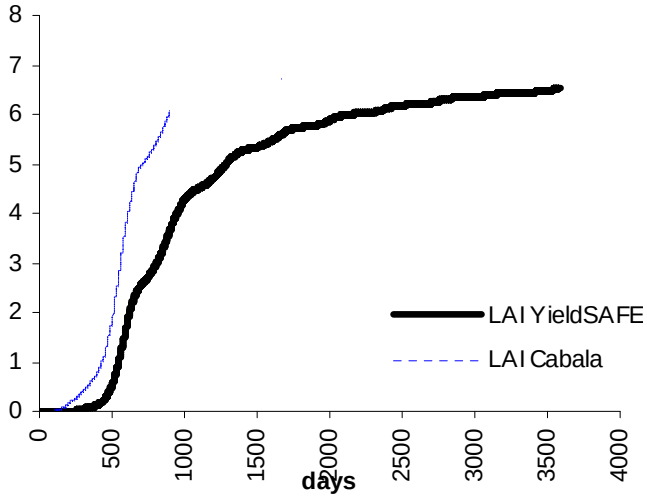










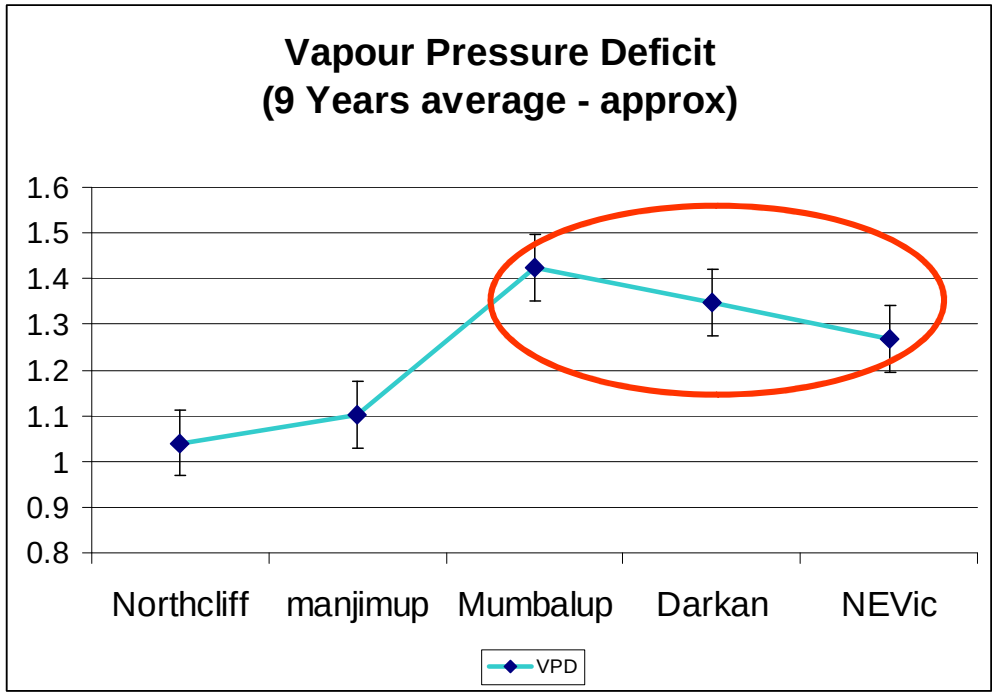


Next Step: Below ground dynamics for water reduced growth. Problems expected…

CABALA vs YieldSAFE

Improving simulations…

Quick look at VPD



The higher the VPD,
The higher the transpiration rate

Adjust site transpiration rate γ_t
(water needed to produce biomass)

CABALA vs YieldSAFE

Actual Yield

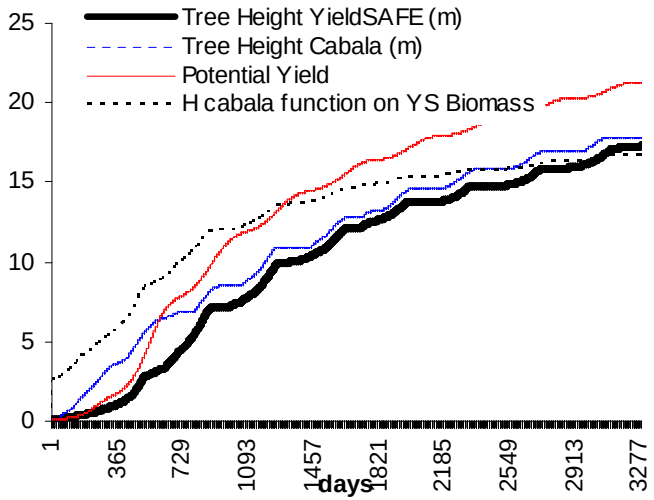
Mumbalup

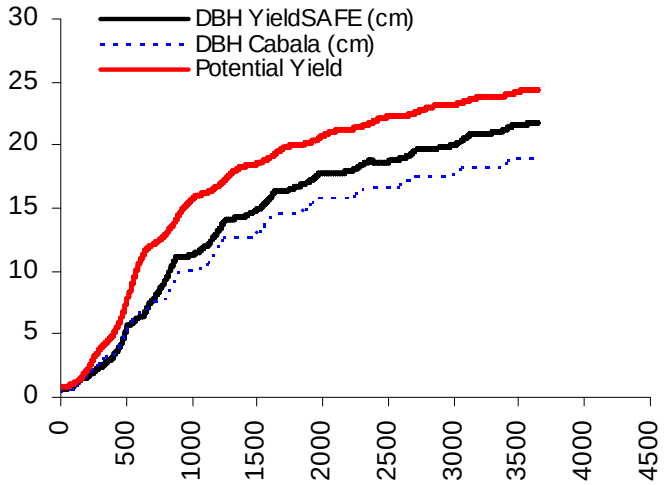
Before
$\gamma_t = 0.0003$

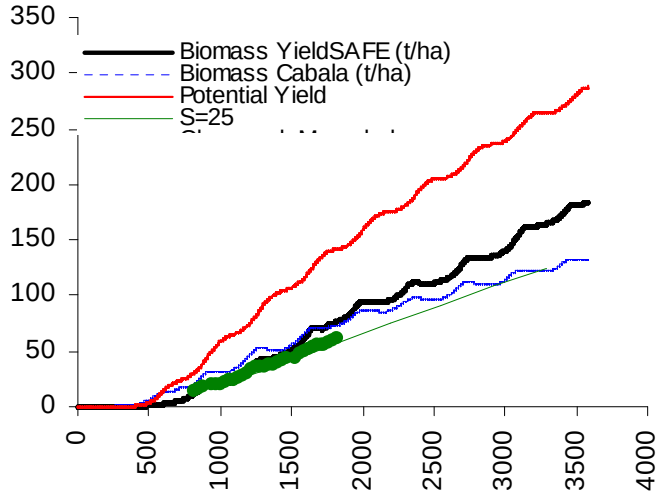
SoilDepth(mm) 1500

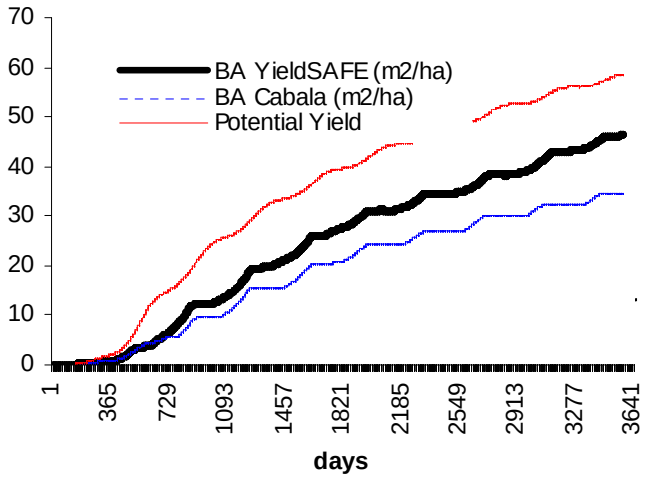
Soil Texture US-ClayLoam

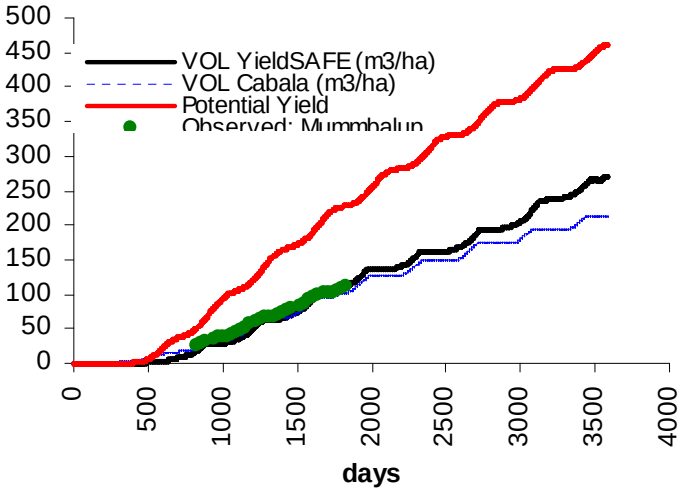
Density 1250

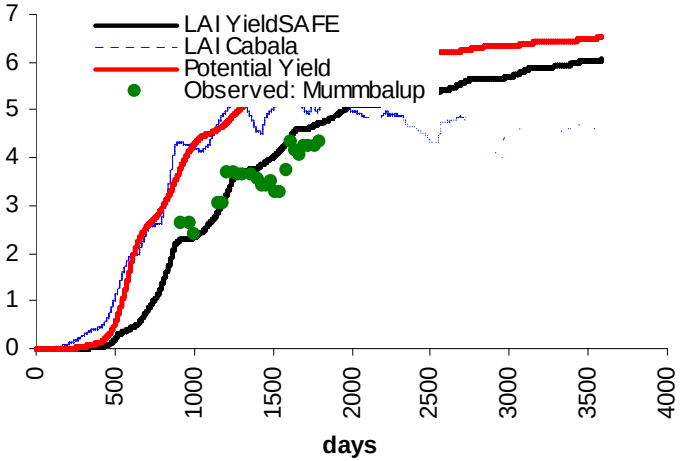












CABALA — YieldSAFE — YieldSAFE Potential • Observed data

CABALA vs YieldSAFE

Actual Yield

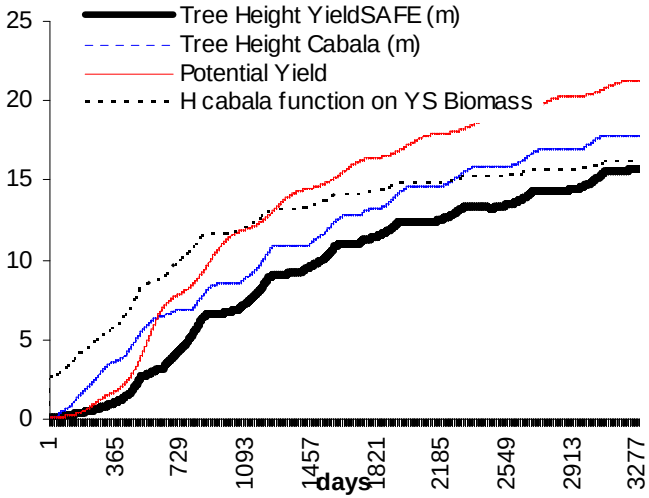
Mumbalup

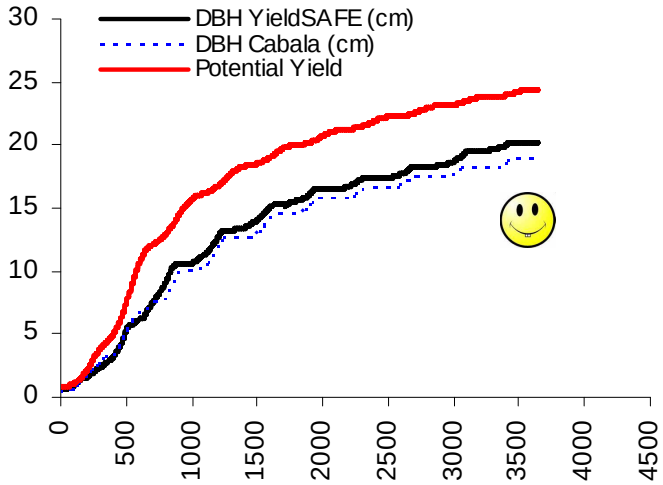
After
$\gamma_t = 0.0004$

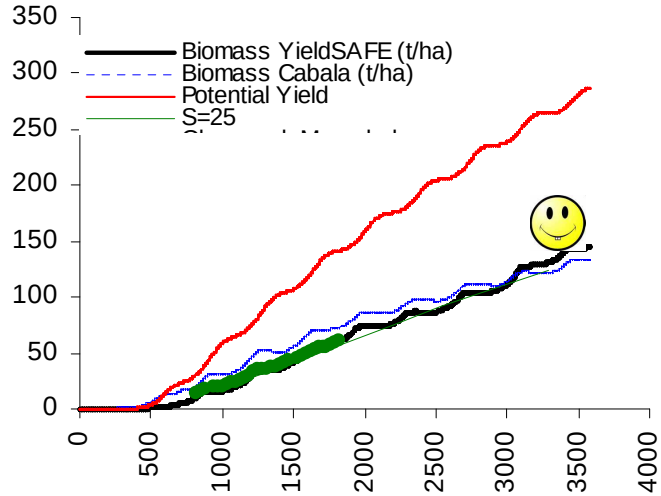
SoilDepth(mm) 1500

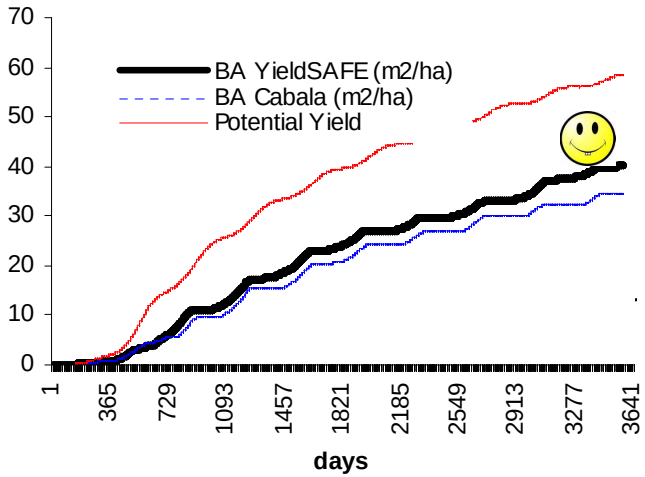
Soil Texture US-ClayLoam

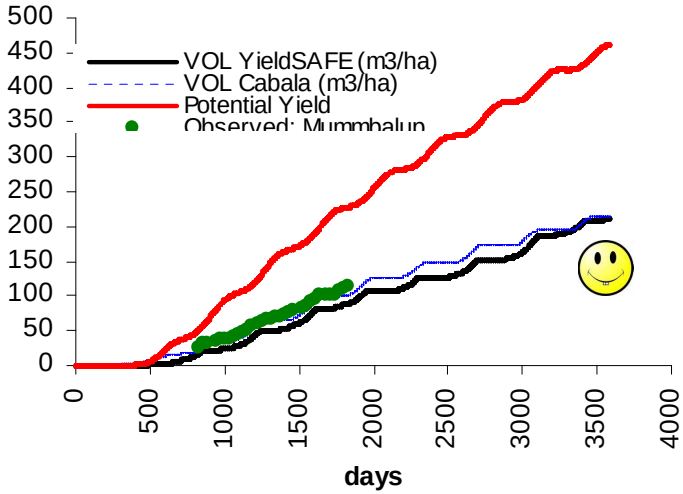
Density 1250

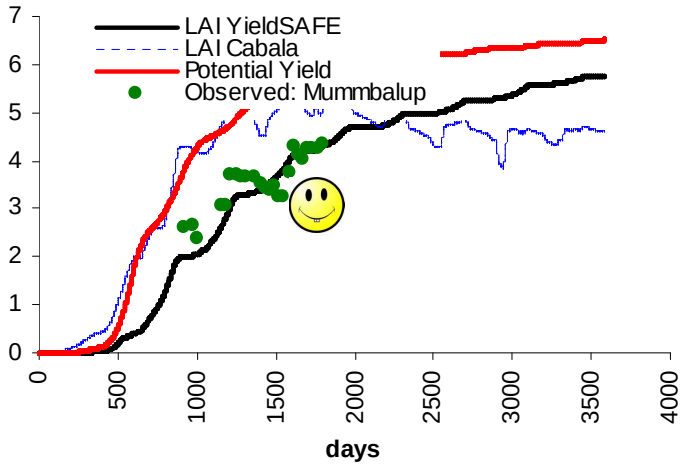












CABALA — YieldSAFE — YieldSAFE Potential • Observed data

CABALA vs YieldSAFE

Actual Yield

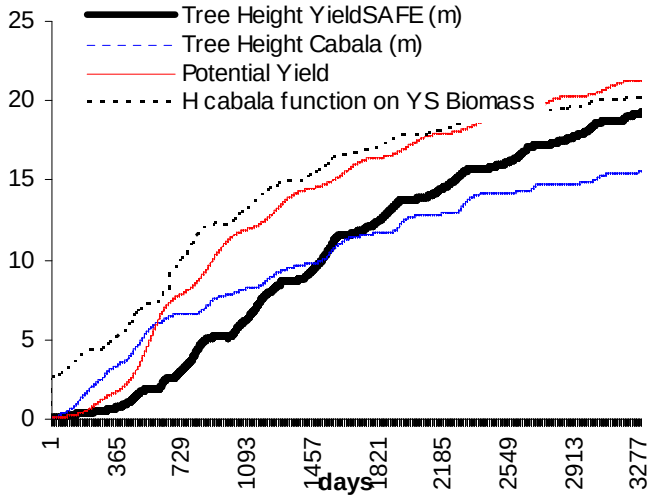
Darkan

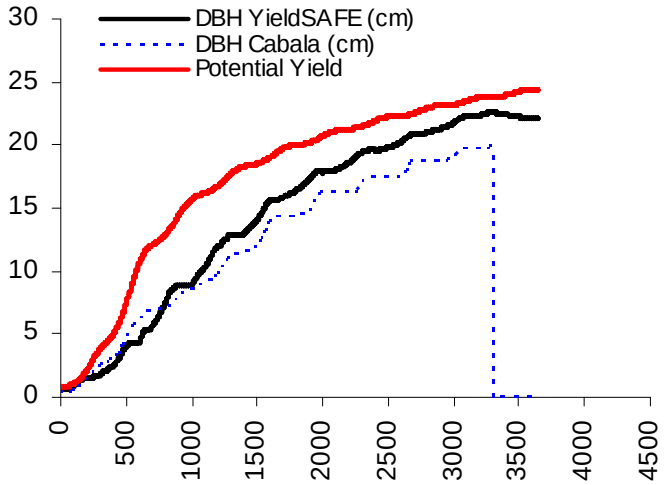
Before
$\gamma_t = 0.0003$

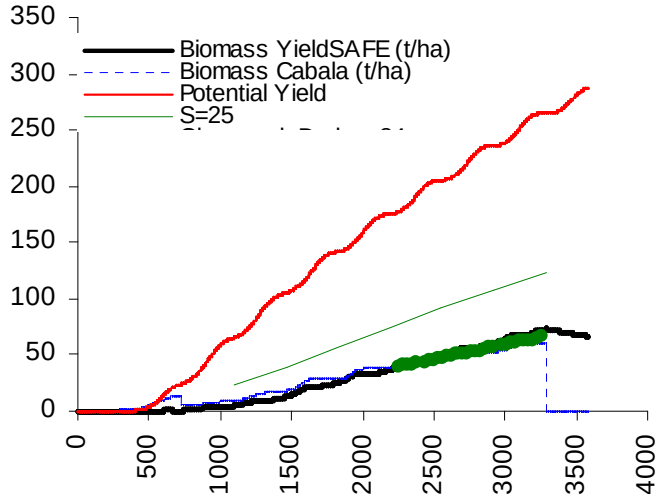
SoilDepth(mm) 3000

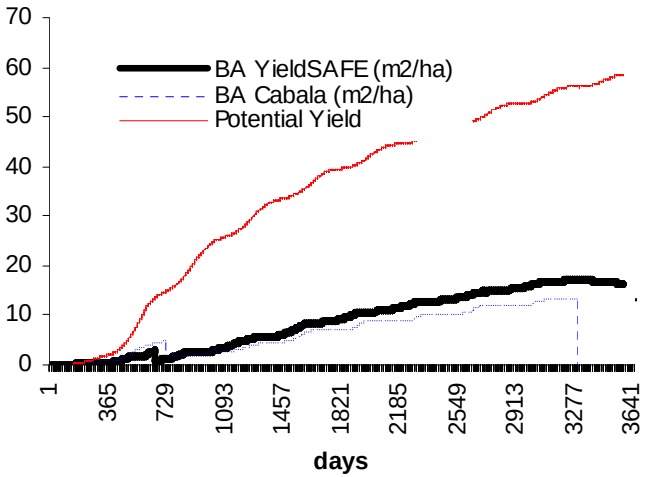
Soil Texture US-LoamySand

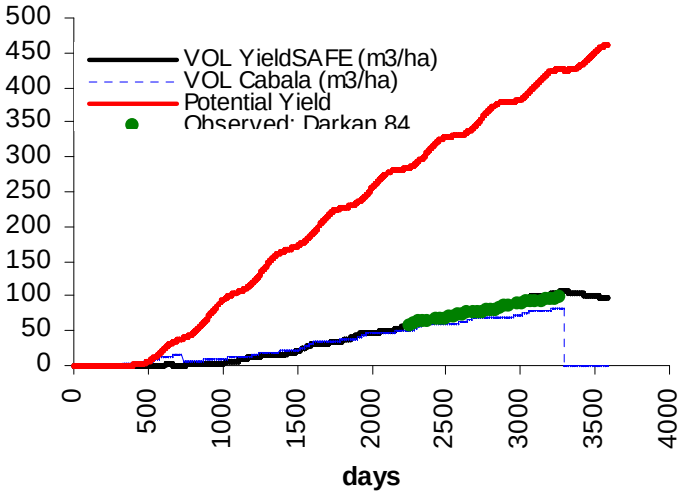
Densitv **430**

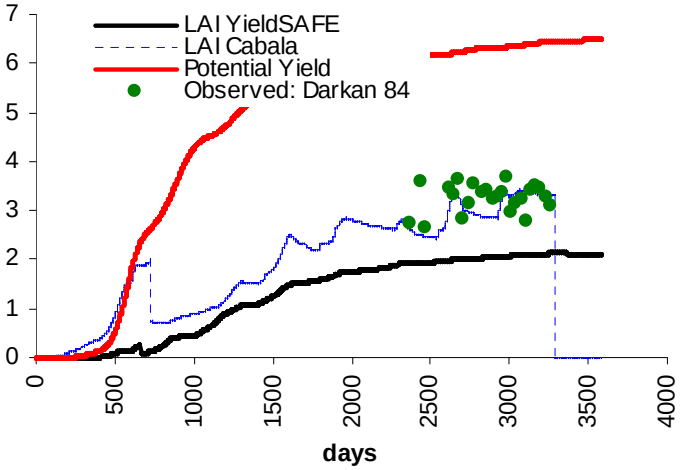












CABALA YieldSAFE YieldSAFE Potential Observed data

CABALA vs YieldSAFE

Actual Yield

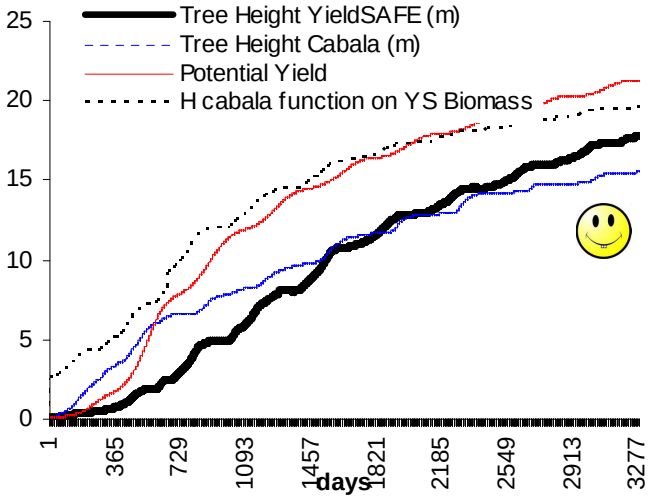
Darkan

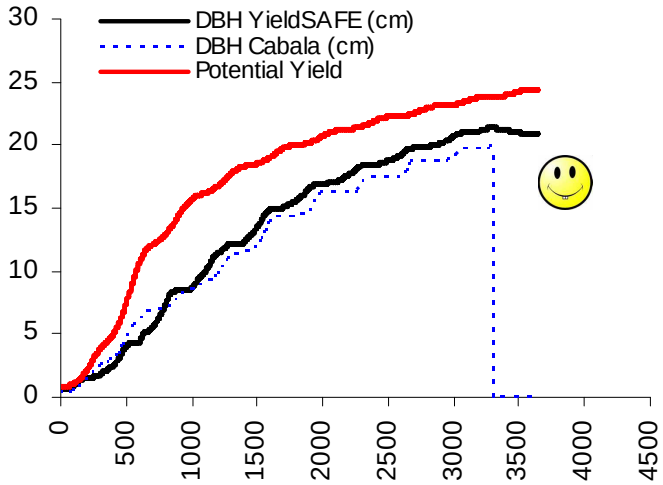
After
$\gamma_t = 0.0004$

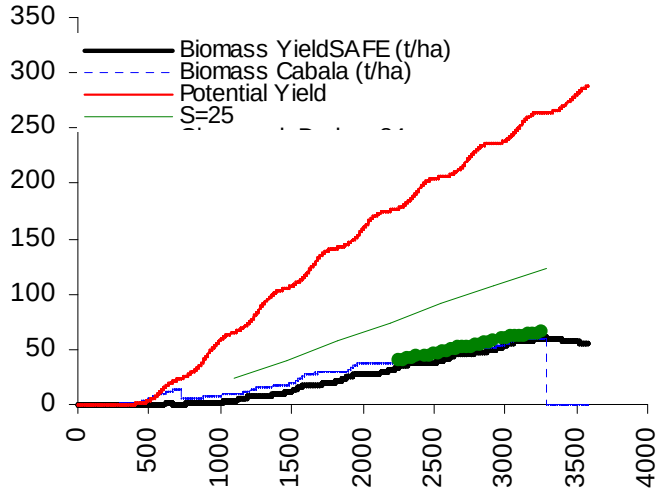
SoilDepth(mm) 3000

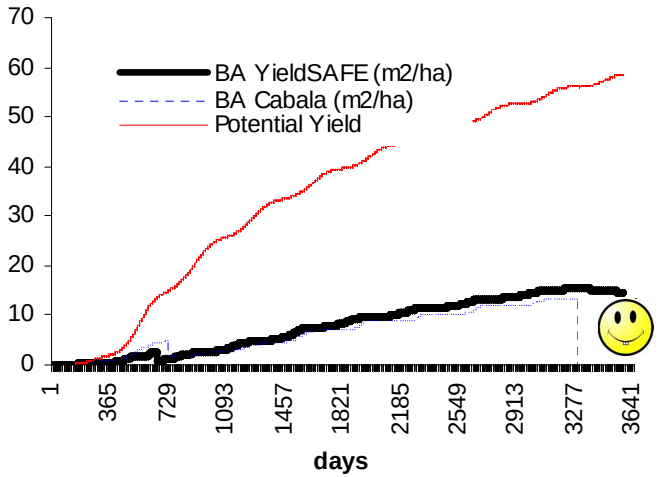
Soil Texture US-LoamySand

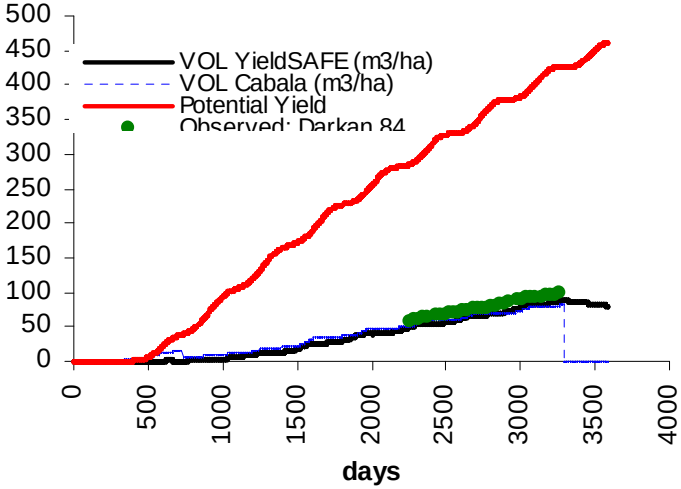
Densitv **430**

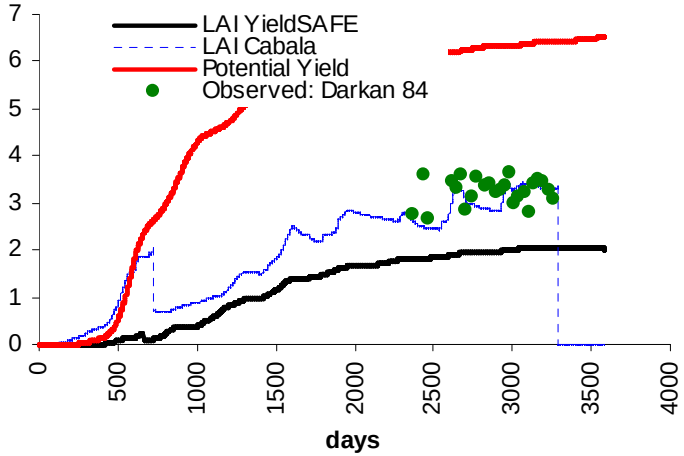












CABALA — YieldSAFE — YieldSAFE Potential • Observed data

CABALA vs YieldSAFE

Actual Yield

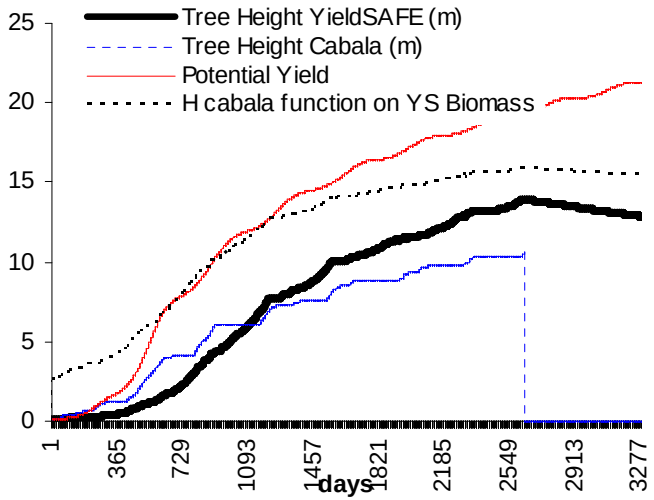
NE Vic

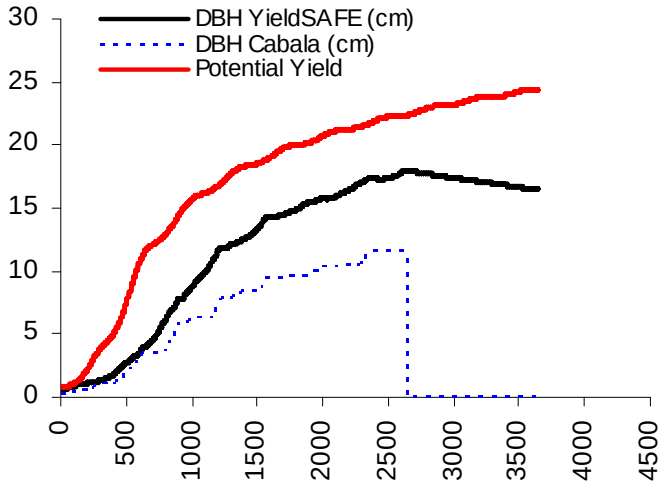
Before
$\gamma_t = 0.0003$

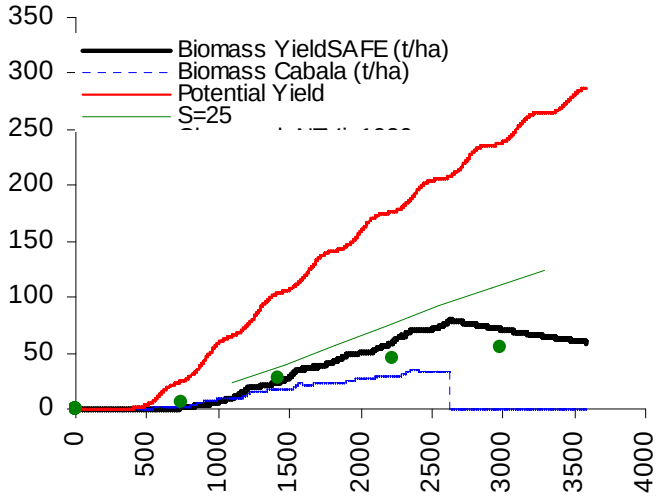
SoilDepth(mm) **220**

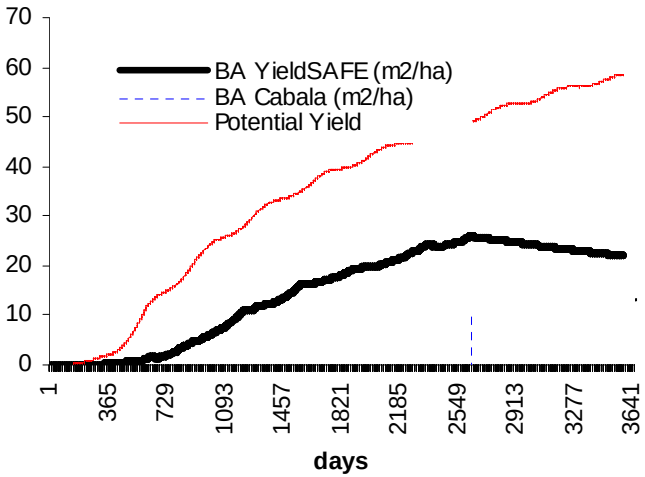
Soil Texture US-siltyClLoam

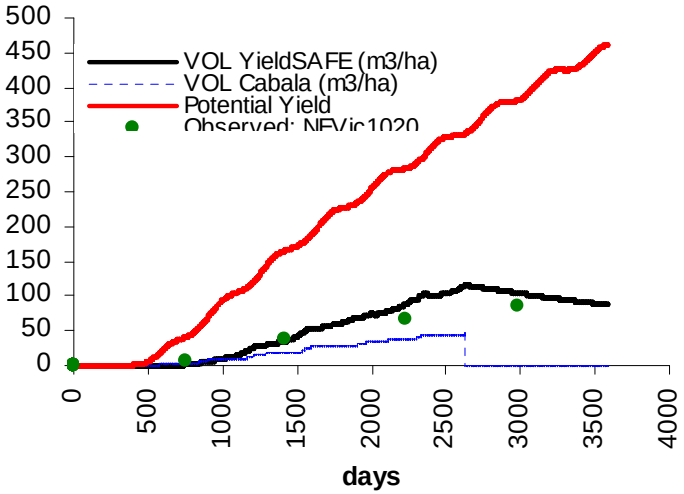
Densitv 1020

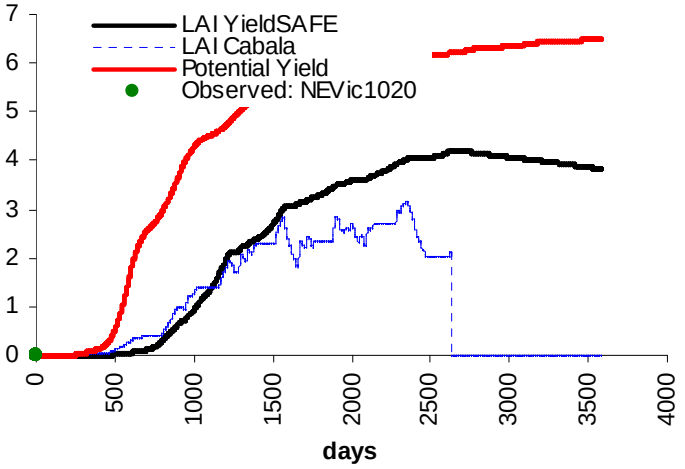












CABALA — YieldSAFE — YieldSAFE Potential • Observed data

CABALA vs YieldSAFE

Actual Yield

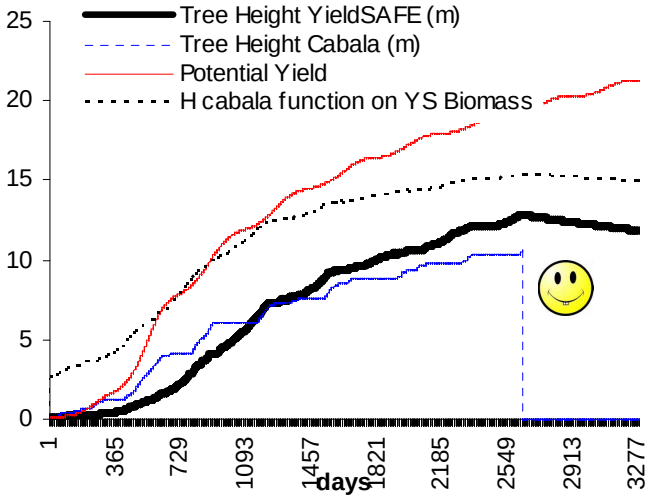
NE Vic

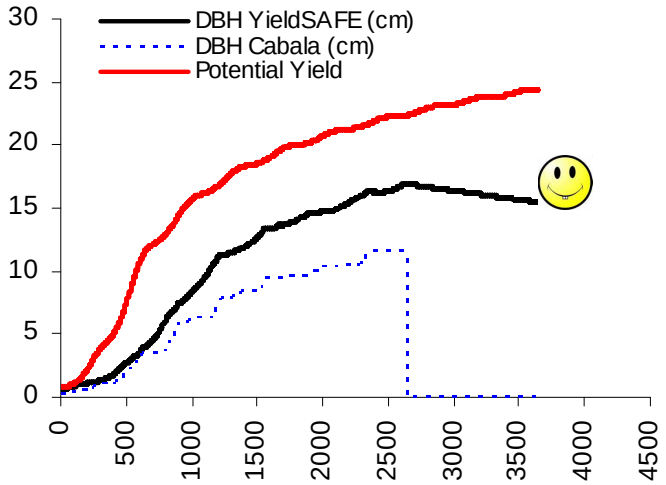
After
$\gamma_t = 0.0004$

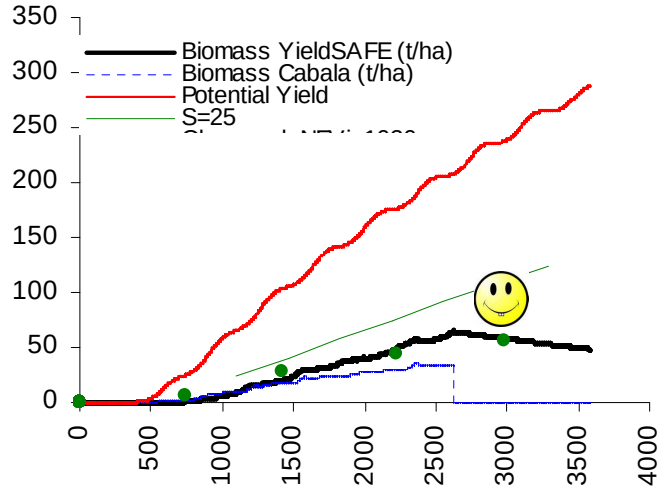
SoilDepth(mm) **220**

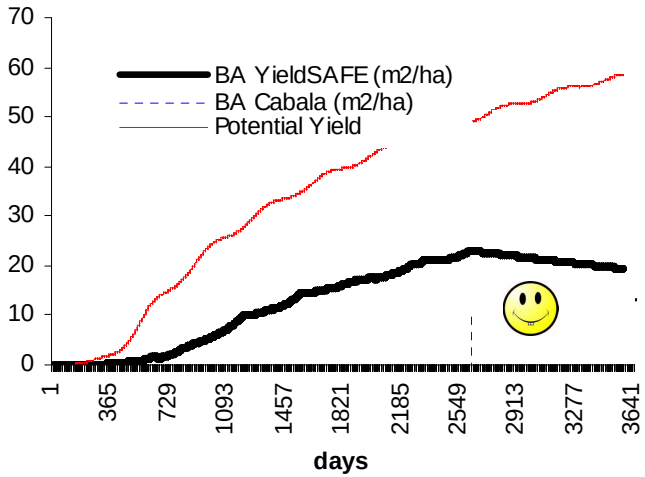
Soil Texture US-siltyClLoam

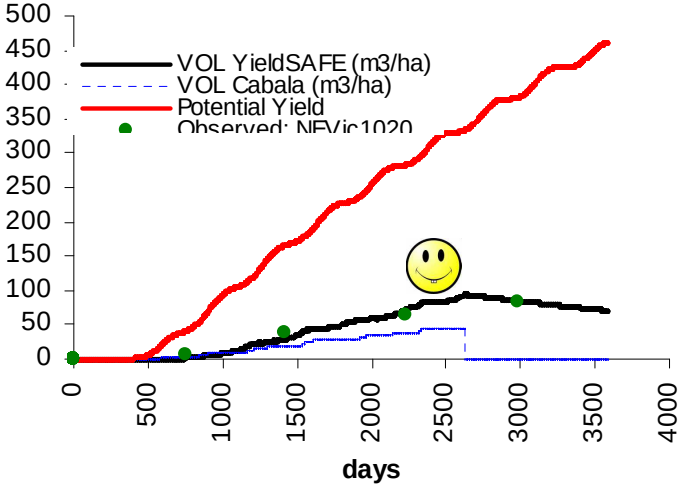
Densitv 1020

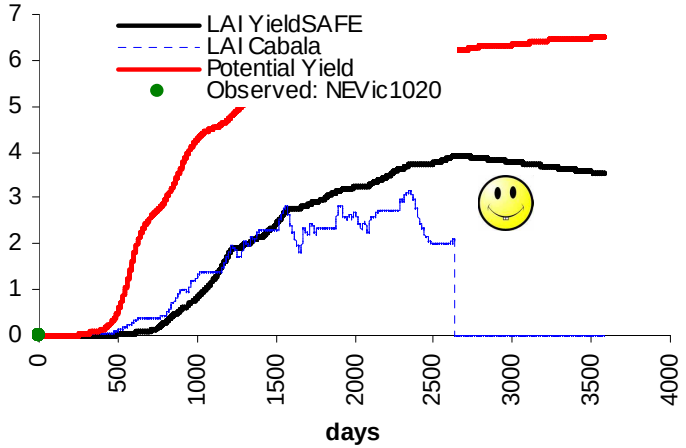












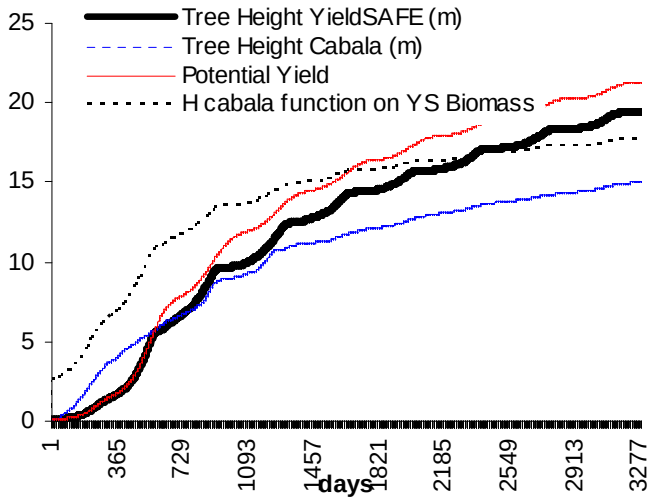
CABALA — YieldSAFE — YieldSAFE Potential • Observed data

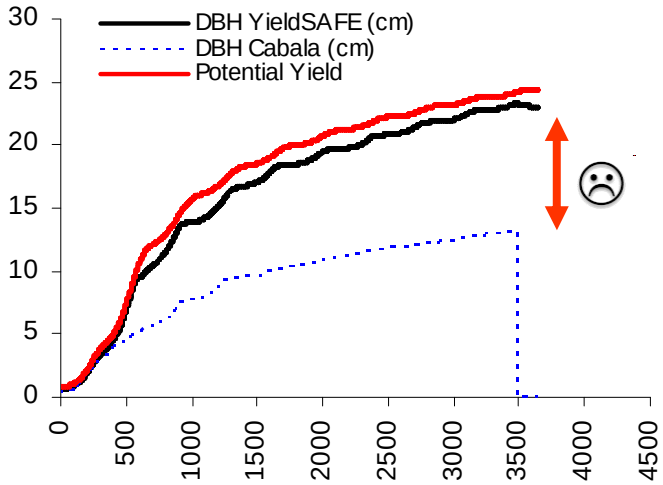
CABALA vs YieldSAFE

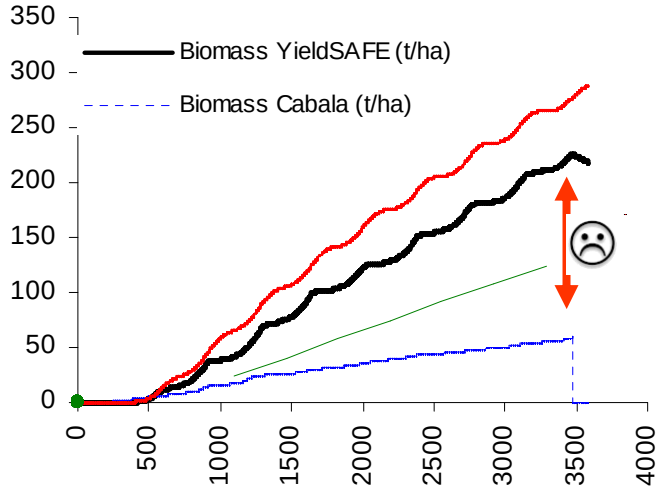
Actual Yield

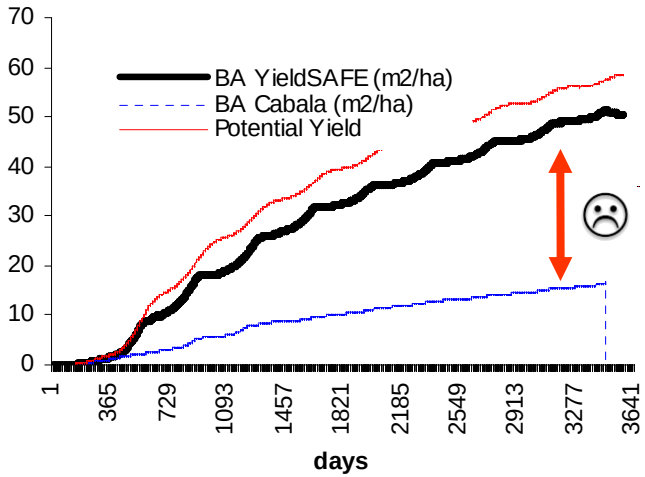
Averys

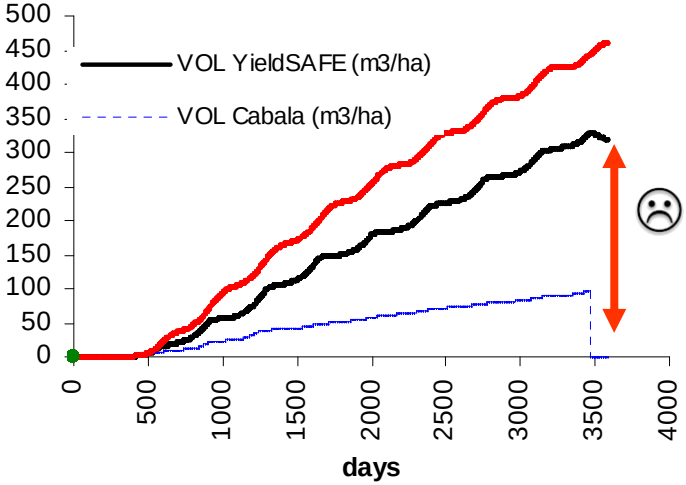
Too complex for YieldSAFE
No nitrogen model

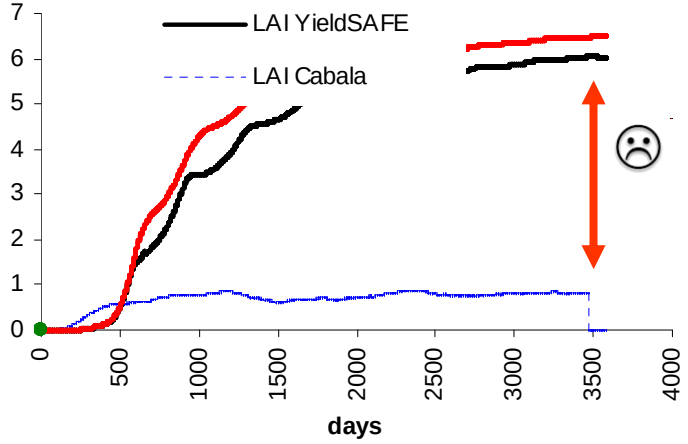










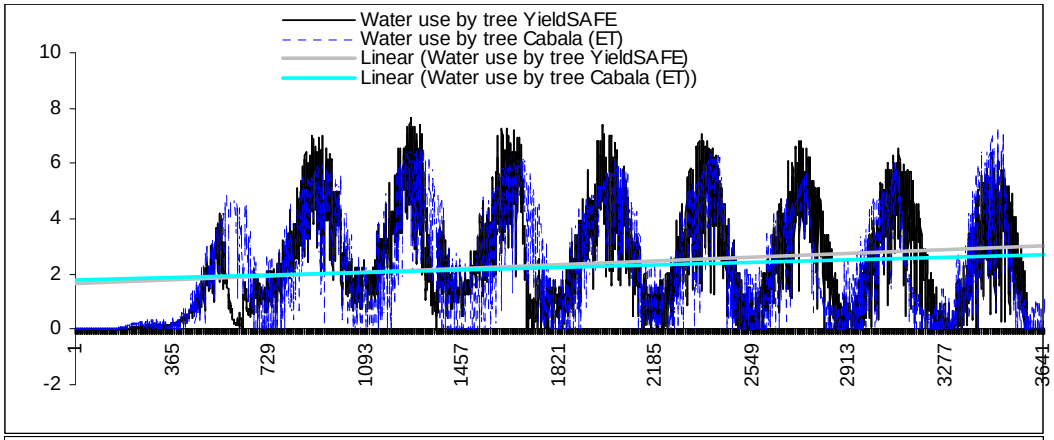


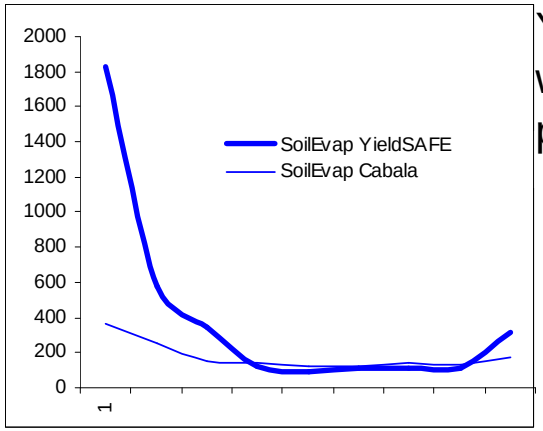
CABALA — YieldSAFE — YieldSAFE Potential • Observed data

CABALA vs YieldSAFE

Looking at water dynamics…

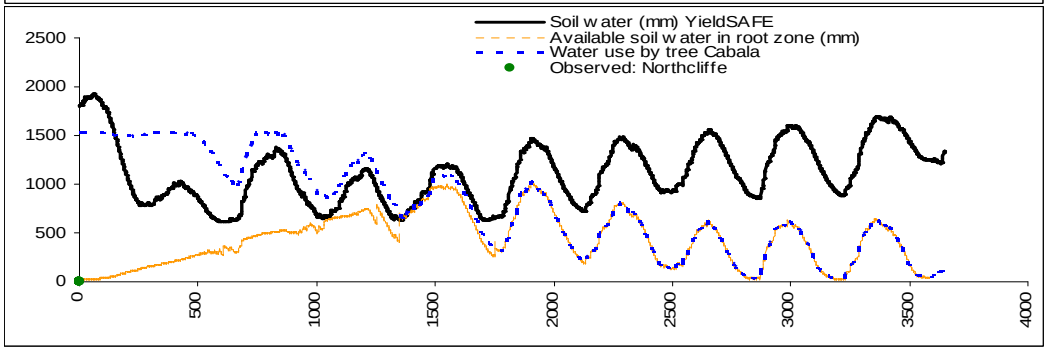
Northcliffe

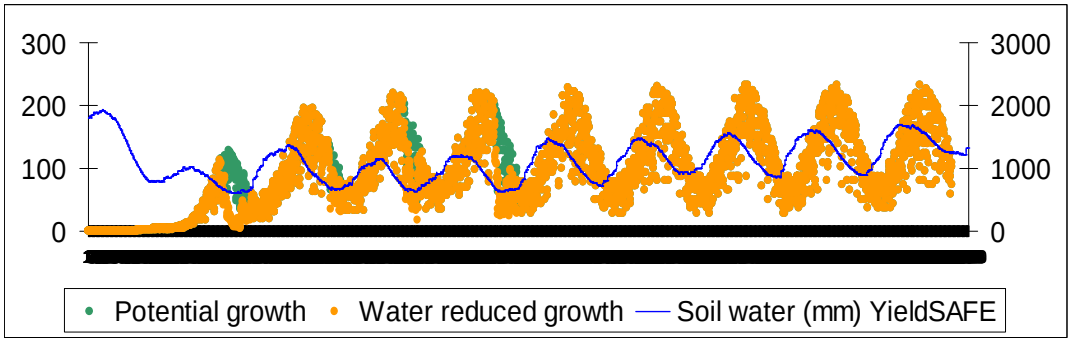


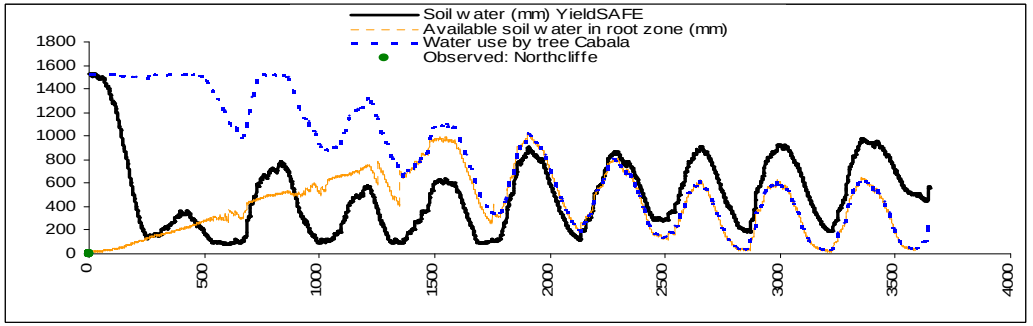


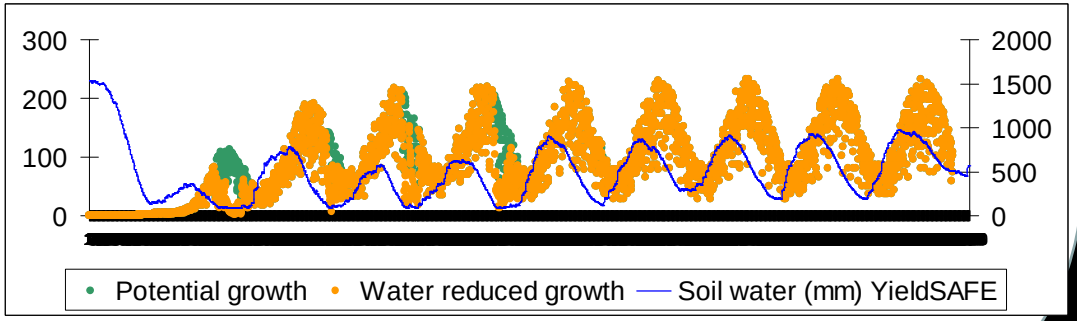
YieldSAFE – Total soil water, using general parameters for soil type

Cabala – Available soil water









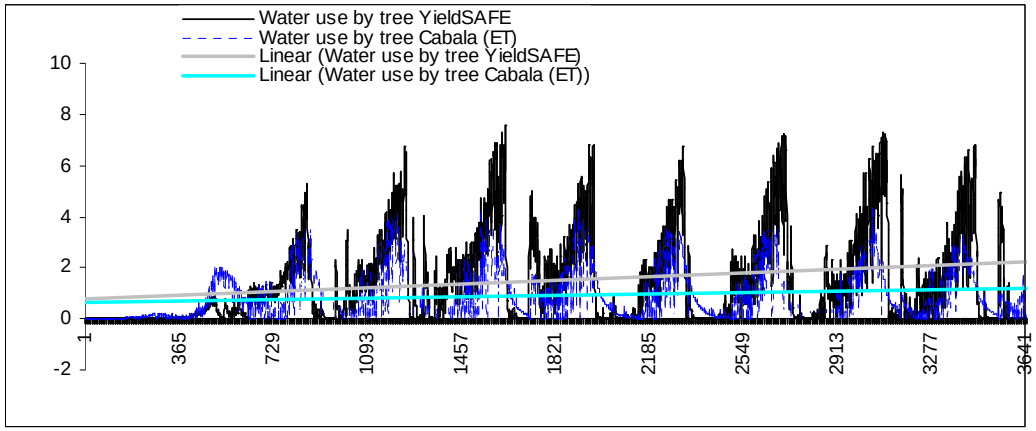
Exercise…

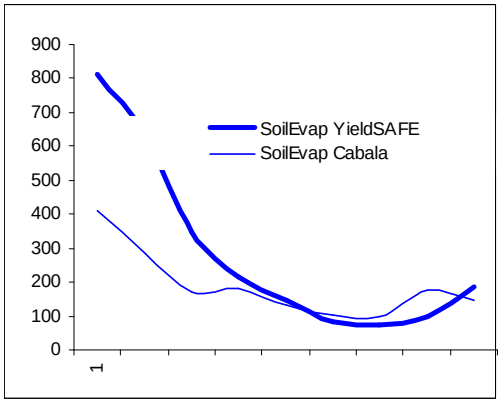
$\theta_r = 0$ and θ_s = Cabala AW

CABALA vs YieldSAFE

Looking at water dynamics…

Mumbalup





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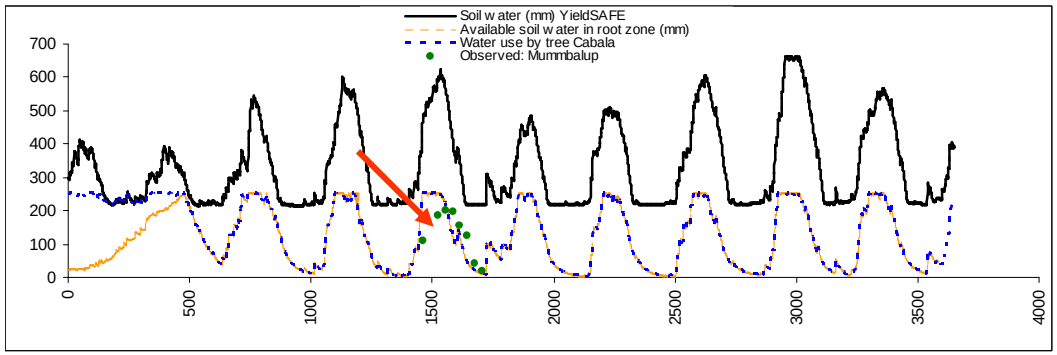
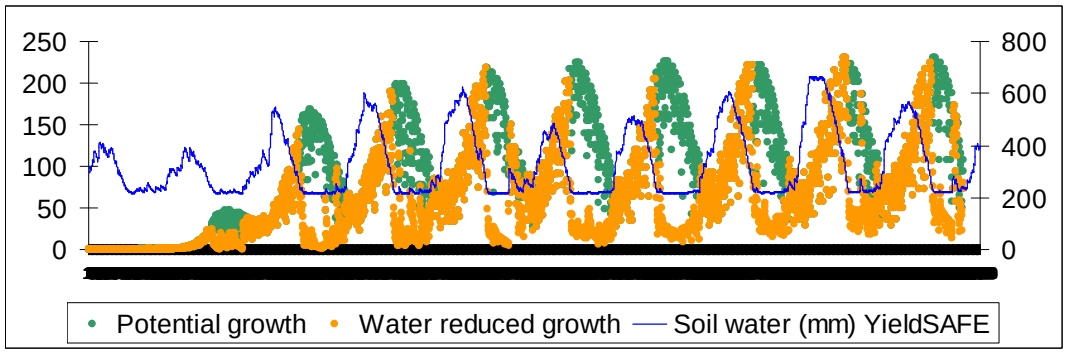
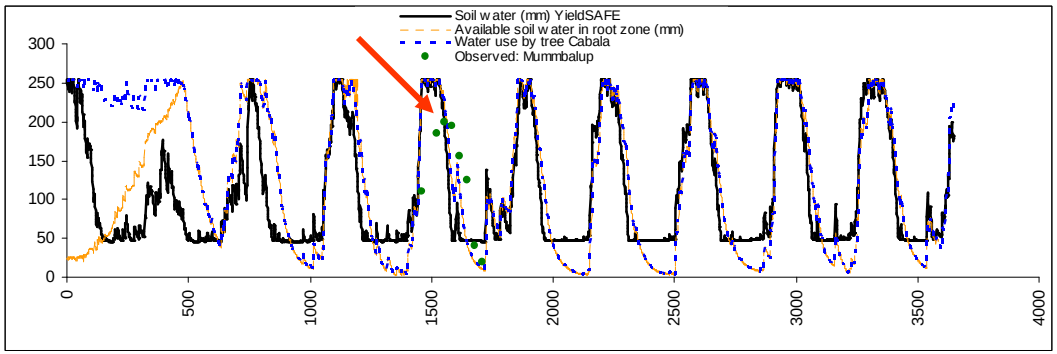
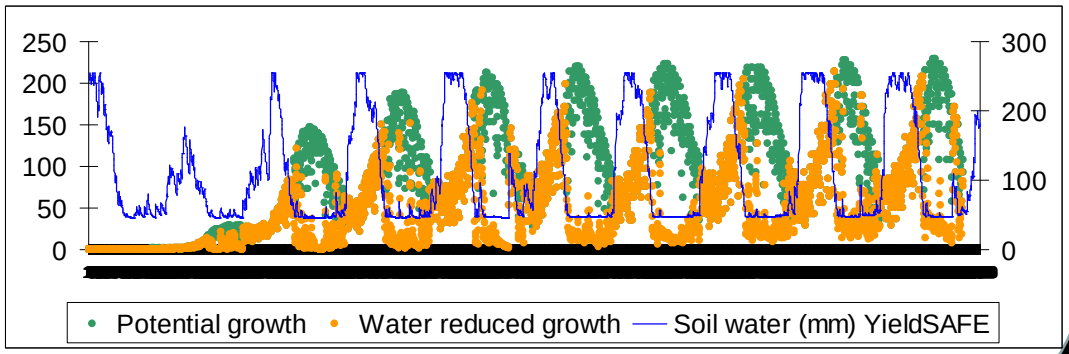








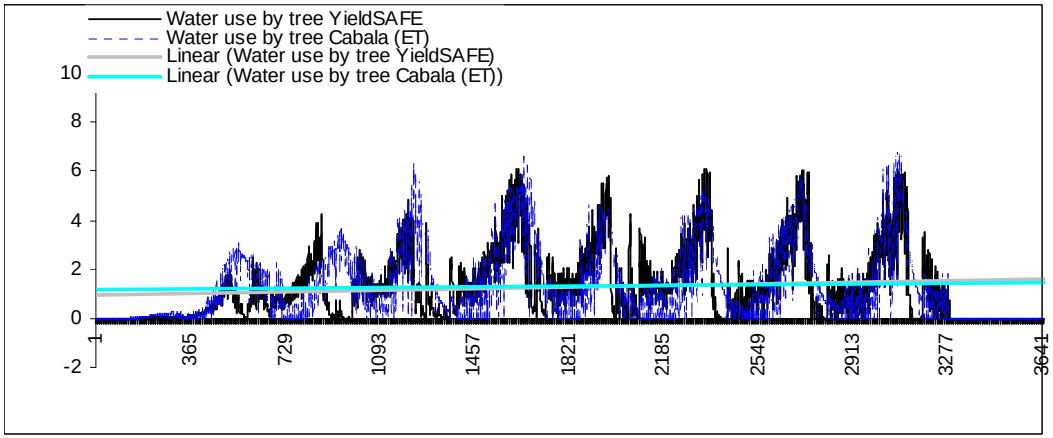
Exercise…

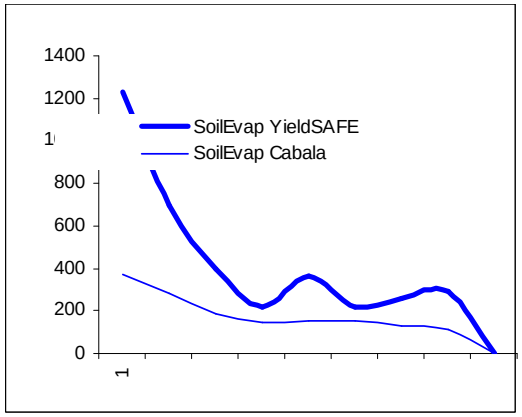
$\theta_r = 0$ and θ_s = Cabala AW

CABALA vs YieldSAFE

Looking at water dynamics…

Mamjimup





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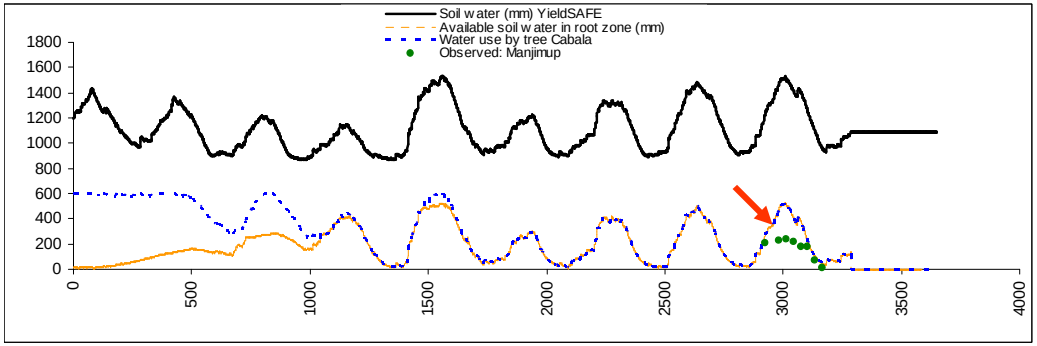
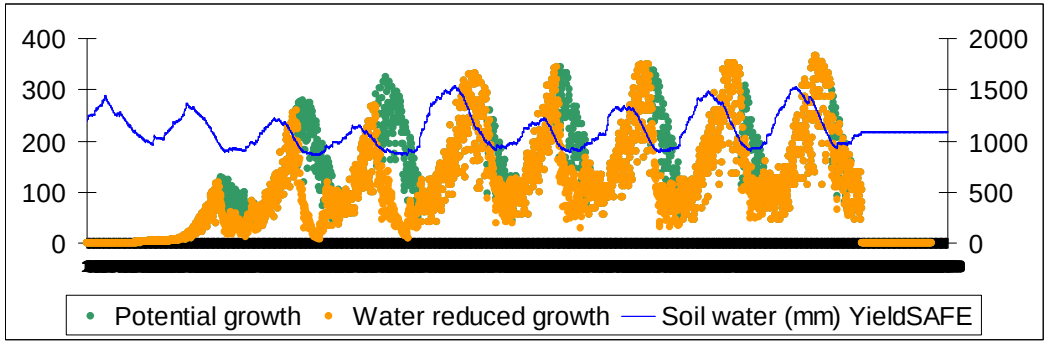
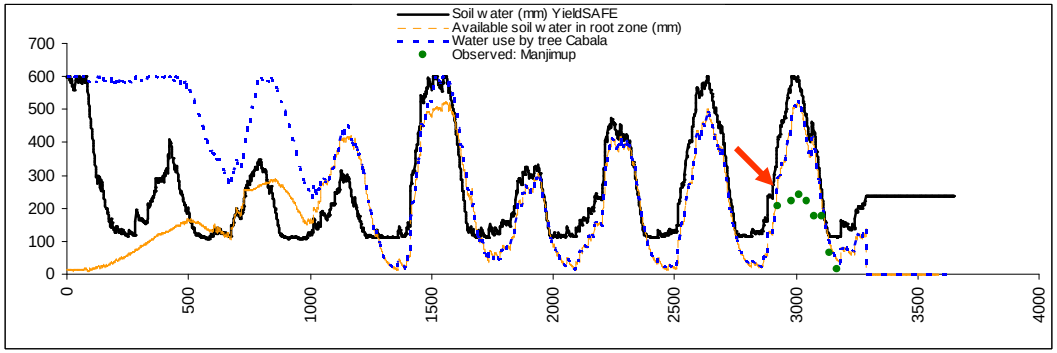
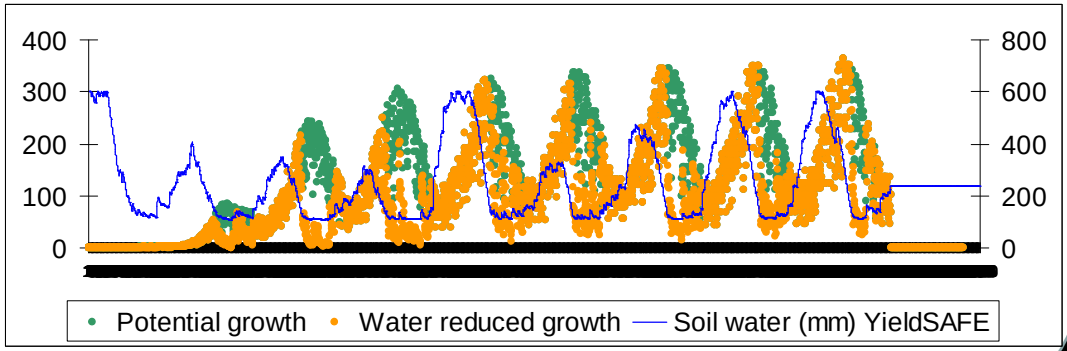








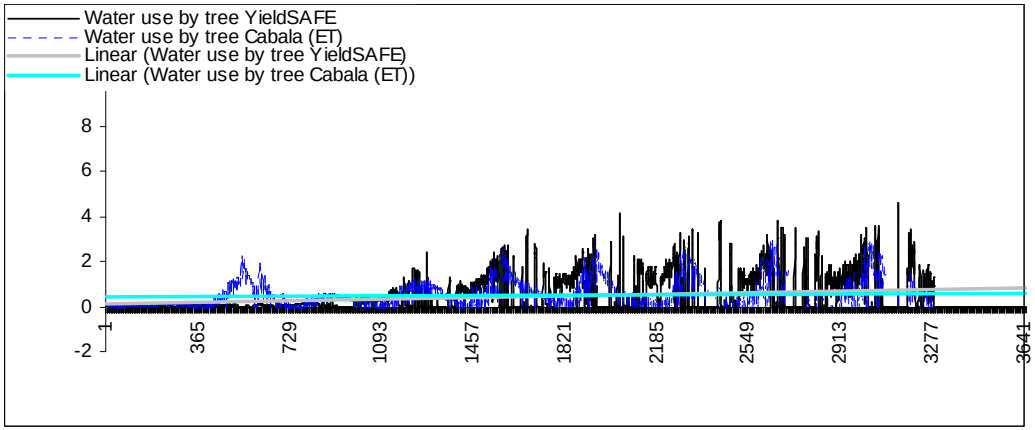
Exercise…

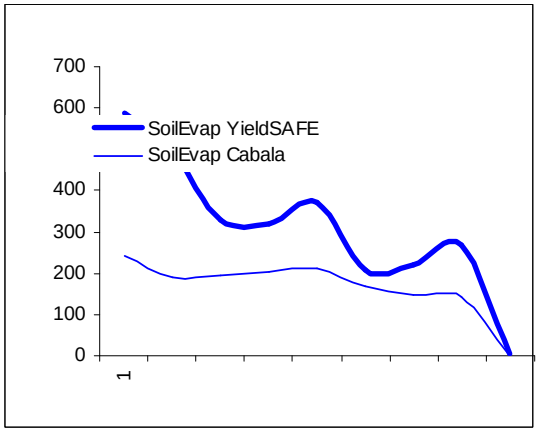
$\theta_r = 0$ and θ_s = Cabala AW

CABALA vs YieldSAFE

Looking at water dynamics…

Darkan





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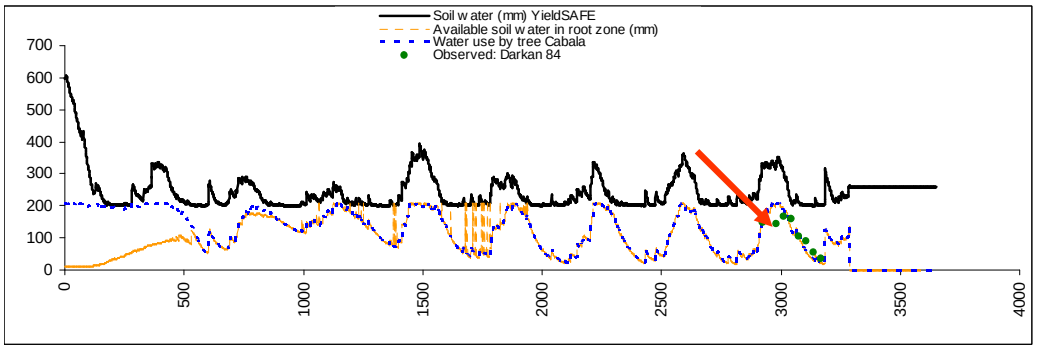
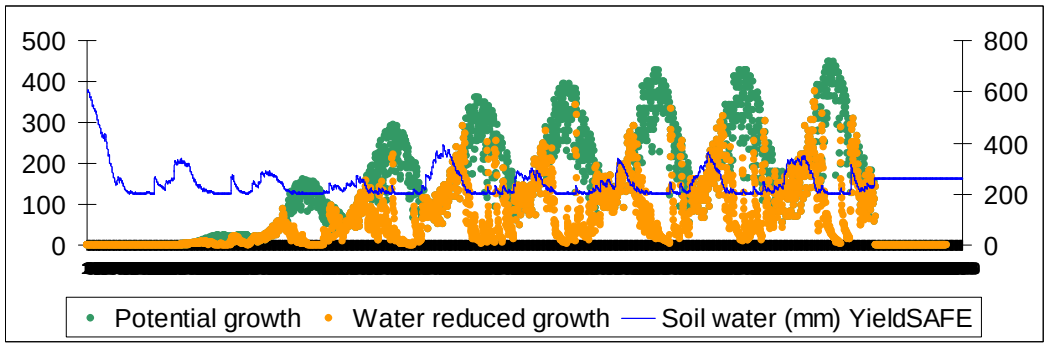
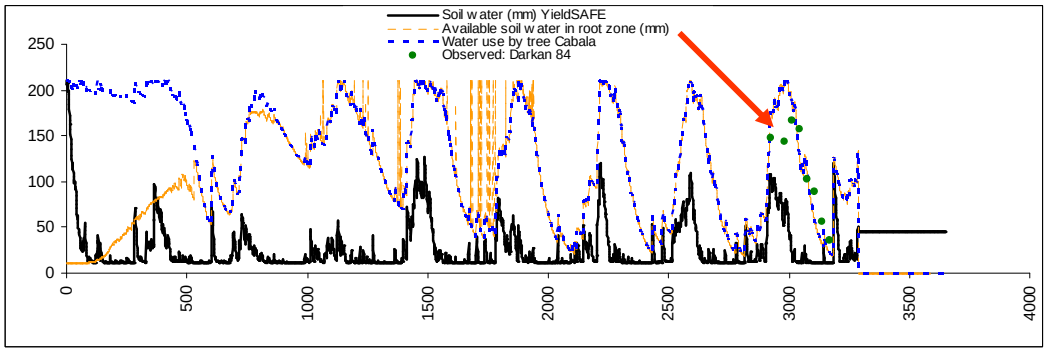
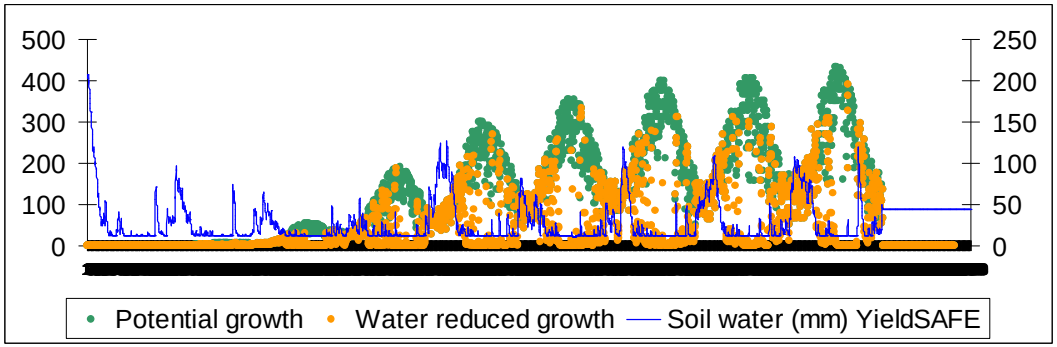








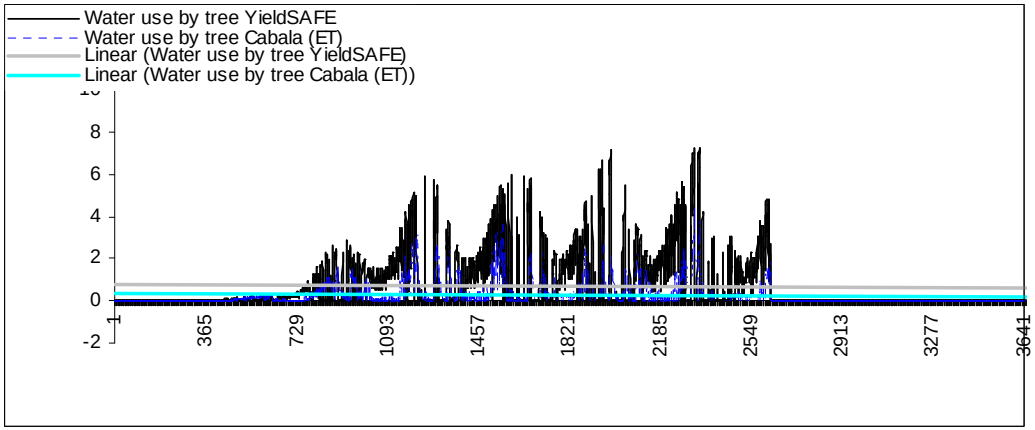
Exercise…

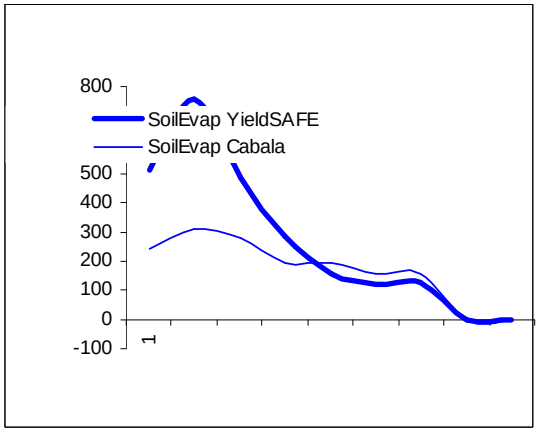
$\theta_r = 0$ and θ_s = Cabala AW

CABALA vs YieldSAFE

Looking at water dynamics…

NE Vic





YieldSAFE – Total soil water, using general parameters for soil type

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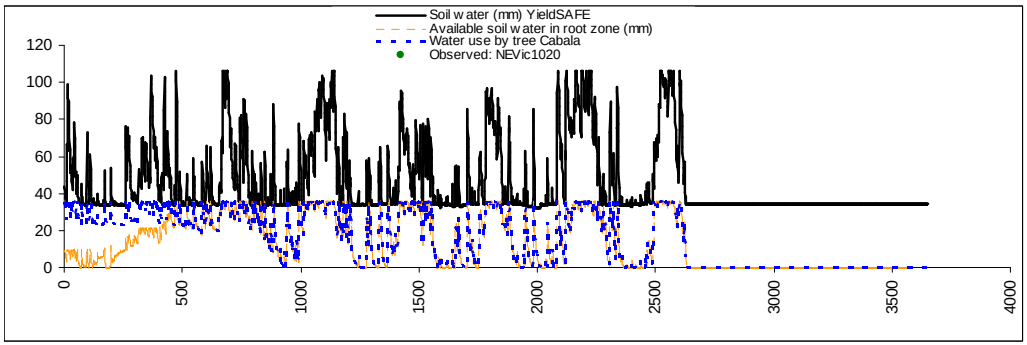

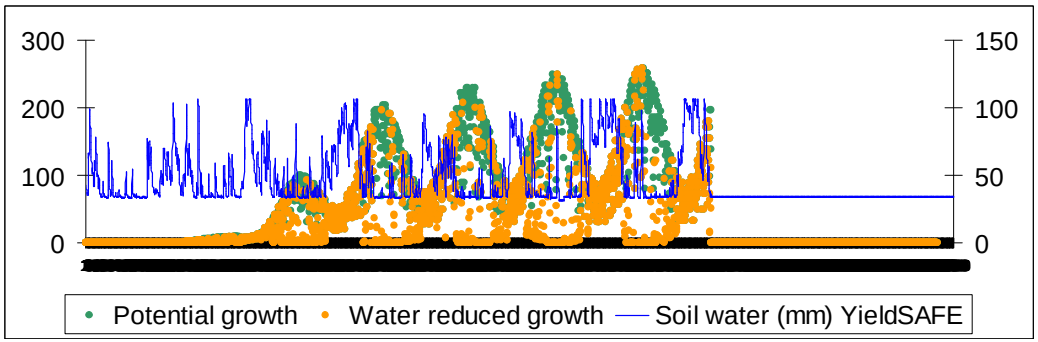

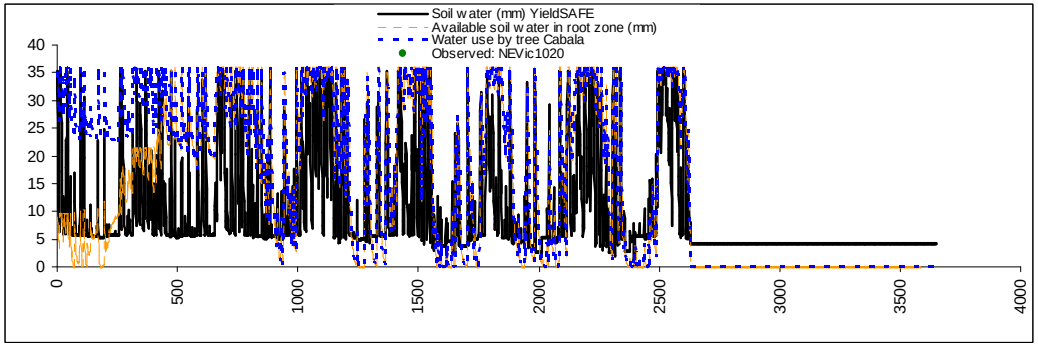

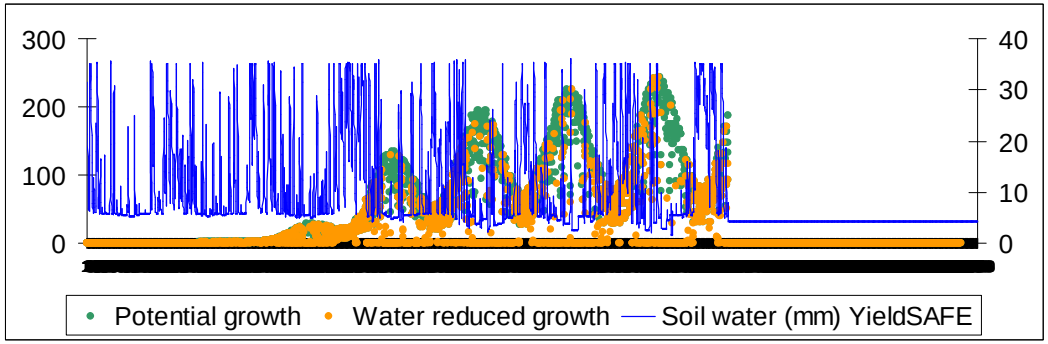

Exercise…

$\theta_r = 0$ and θ_s = Cabala AW

Mission resume...

To bring home…

YieldSAFE satisfactorily mimics CABALA for “Normal” conditions

Only water reduced impacts should be considered

Australia is BIG! Corrections for higher VPD areas should be made

YieldSAFE can be used for preliminary assessments, followed by Cabala

Soil is “tricky” to compare as Cabala calculates AW and YieldSAFE calculates total soil water and each one uses different equations in yield reduction factors

US soil parameters (12 classes) seem to have has an acceptable behaviour

Still have to work the results with empirical models and inventory data ”back home”

Good stimulus to continue working with yieldSAFE. Possibly with CC data

To eventualy stay here…

YieldSAFE might be useful for the 1 000 000 simulations as “preliminaries”.

YieldSAFE is “Open Source”… no restrictions/license for use

Acknowledgements

Michael Battaglia, Jody Bruce, Auro Almeida

Philip Smethurst

Mark Sheldon-Stemm, Geoff Downes

CSIRO Hobart in general for the

WONDERFULL Time

(although ferociously rainy!)